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Original Contribution

Limited Knowledge About Hydatidosis Among Farmers in Northwest Portugal: A Pressing Need for a One Health Approach

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Abstract: Hydatidosis is a re-emerging disease. Farmers are a vulnerable population; however, little is known about their awareness of this disease. The purpose of this study was two-fold: (1) to assess sheep and goat farmers' awareness of, perceptions of, and attitudes towards parasitic zoonoses and hydatidosis and (2) to identify the preferred means for promotion of information about hydatidosis. A cross-sectional study was conducted. An in-person questionnaire was constructed and administered to 279 individuals. A coprological survey in shepherd dogs was performed using 88 faecal samples. SPSS version 18.0 was used for statistical analysis. Farmers reported several risk practices (69% practice home slaughtering, 46% do not deworm the dogs, 58% of these dogs have contact with other animals) and very little knowledge about hydatidosis (97% have never heard about it). Nevertheless, 75% of the farmers demonstrated interest in receiving information, mainly from a veterinarian. A wide diversity of potentially zoonotic parasites (*Trichuris* spp., Ancylostomatidae, *Toxocara* spp., Taeniidae) was found in 61% of the dogs. This survey revealed farmers' lack of knowledge in relation to hydatidosis and a high prevalence of potentially zoonotic parasites in dogs, thus pointing to the need for health education and a closer collaboration between veterinarian and public health professionals.

Keywords: echinococcosis–hydatidosis, zoonosis, farmers, awareness, one health

Introduction

Echinococcosis affects 2–3 million people globally and has an annual incidence of 200,000 cases, yet remains a neglected zoonosis (Atkinson et al. 2013). Cystic echinococcosis, also known as hydatidosis, not only causes severe symptoms and possible death in humans, but also results in economic livestock-associated production losses. This disease continues to be a major public health problem in several countries, and in many others it constitutes an

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emerging and re-emerging disease (Jenkins et al. 2005; Moro and Schantz 2009).

Cystic echinococcosis is currently among the five most frequently diagnosed diseases in the Mediterranean region (Sadjadi 2006), which is considered hyperendemic (McManus et al. 2003). In Portugal, only Évora district, located in the southern portion of the country, has been considered hyperendemic (Morais 2007), but the overall country is currently considered sine-endemic (Morais 2013). Nonetheless, the presence of the parasite in Portugal has been reported recently in both domestic animals and humans (Cardoso et al. 2014). Moreover, it should be noted that the G1 strain that prevails in Portugal is the most pathogenic form, and has been associated with severe hydatid disease in humans (Morais 2007). The actual prevalence of cystic echinococcosis in Portugal is unknown due to the lack of efficient reporting systems.

Echinococcus granulosus is a cestoda whose life cycle involves canids as definitive hosts for the intestinal tapeworm and ungulates as intermediate hosts. The parasite eggs are discharged with the faeces of the definitive host into the environment and may be ingested by the intermediate hosts, causing hydatidosis. Transmission to humans frequently results from close contact with infected dogs carrying the parasite's eggs on their fur or, indirectly, as a result of ingestion of contaminated water or food (Romig et al. 2006). Worldwide, human, ovine and bovine hydatidosis prevalence coexist in the same regions (Carmena et al. 2008). The communities involved in livestock production, mainly sheep, usually have higher human rates of infection, demonstrating that the sheep-dog cycle is very important from the public health perspective (Carmena et al. 2008; Craig et al. 2007).

Regions characterized by a high density of canids and with home slaughtering practices, associated with specific socio-economic and cultural conditions, contribute greatly to the transmission of this disease, as well as the lack of information and awareness of the individuals in a community (Seimenis 2003; Varcasia et al. 2007). Being illiterate is also a known risk factor (Seimenis 2003). Some of these risk factors for disease have been recognized in Ponte de Lima, Portugal, which prompted this study.

The main aims of this study were to assess the awareness of sheep and goat farmers in relation to parasitic zoonoses, in general, and hydatidosis, in particular; determine the prevalence of known risk factors related to animal health and slaughtering of livestock (namely home slaughtering, offal disposal, dog-keeping practices, use and frequency of dogs' anthelmintic treatment); determine the prevalence of intestinal parasites in shepherd dogs; and assess the preferred means for promotion of information about hydatidosis to sheep and goat farmers.

Materials and Methods

Study Area

The studies conducted in Portugal about hydatidosis were done in the centre and south of the country. The authors conducted the study in the county of Ponte de Lima, located in the district of Viana do Castelo, in northwest of Portugal (Fig. 1), because it is a rural municipality in the North, with agriculture and animal breeding on small and family size farms as the main source of income.

The region has 43,498 inhabitants dispersed over 320.26 km^2 (Anonymous 2011) and there is a high density of free roaming dogs. Home slaughtering is very common, and is also conducted as part of traditional festivals. Actual prevalence of the disease in Ponte de Lima or in the north of Portugal is unknown due to the lack of reported cases.

Sample Selection and Design of the Questionnaire

The farmer survey was conducted using convenience sampling and was designed to obtain representative samples and adequate geographical coverage. The sample included sheep and goat farmers officially registered with the association of animal health protection of the county, which helped with the completion of most of the questionnaires. The design of the questionnaire took into consideration the literature about hydatidosis. Meetings were held with groups of farmers with the aim of gathering information for the preparation of the draft of the exploratory interview. The exploratory interview was then tested and, based on these results, a draft questionnaire designed, tested and reviewed, to determine the terms used and the type of questions to be included. This process resulted in the final questionnaire, composed of a sequence of 20 multiple choice or open-ended questions, aimed at gathering socio-demographic data on farms and farmers (location—civil parish—farmers' age, ownership and number of ruminants, swine and dogs), risk factor practices (home slaughtering, offal disposal, dog-keeping practices, use and frequency of dogs' anthelmintic treatment) and farmers' knowledge of the disease (awareness of the disease

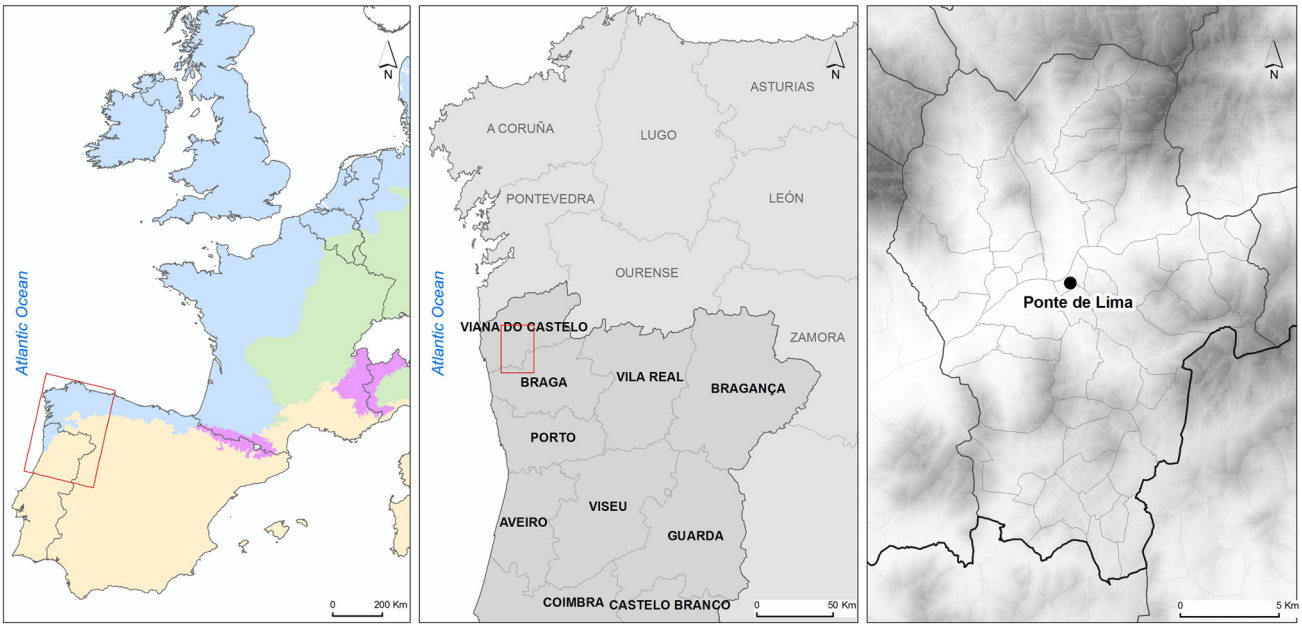

Figure 1. Maps of the sampling area—Ponte de Lima in the district of Viana do Castelo, northwest of Portugal.

and its transmission, and farmers' interest in receiving information on hydatidosis).

Data on the literacy of the respondents were not collected because farmers clearly did not like to respond to this question during the exploratory studies. Nevertheless, data published in a report on the Portuguese agriculture sector and its farmers authored by the National Institute of Statistics in 2005 (INE 2007) revealed that 14% of the Portuguese farmers cannot read or write, 15% can read or write, despite not having attended school, and 53% attended only primary school.

Coprological Analysis

From farms with accessible shepherd dogs, faecal samples were collected, fresh from the grounds and whenever possible, immediately after spontaneous elimination. These samples were placed in plastic containers, all individually identified, stored at 4°C and processed within 48 h. Each sample was examined macroscopically with the purpose of detecting possible proglottides. A single qualitative flotation coprological analysis (Foreyt 2001) was performed on each faecal sample. The identification of parasitic forms was based on morphological characteristics and measurements (Foreyt 2001; Zajac and Conboy 2012). A dog was classified as positive if at least one parasite egg, oocyst or cyst was observed. Positive samples for Taeniidae eggs were submitted to Percoll fractionation of faecal samples to facilitate the molecular analysis to evaluate the presence of *E. granulosus*. Percoll (GE Healthcare ref. 17-0891-01) step gradients were used to perform a partial clean-up and to concentrate parasite eggs in the original faecal sample. Evaluation of the Percoll fractionation was performed as described in the literature (Cardoso et al. 2014). The QIAamp DNA Mini Kit (Qiagen, GmbH, Hilden, Germany) was used to extract the total DNA. The presence of *E. granulosus* DNA in faecal samples was evaluated by using PCRs for the amplification of an *E. granulosus* repeated sequence (Abbasi et al. 2003). These results were analysed by using electrophoresis. DNA samples obtained from *E. granulosus* cysts and from faeces positive for *E. granulosus* were used as positive controls. Primers Eg1121a (5′-GAATGCAAGCAGCAGATG-3′) and Eg1122a (5′-GAG ATGAGTGAGAAGGAGTG-3′) were used to amplify the 133-base pair *E. granulosus* repeated sequence (ERS) fragment present in the genomic DNA.

Data Analysis

Data analysis was conducted using statistical software (Statistical Package for Social Sciences—SPSS version 18.0) and focused on the construction of frequency tables and, in the case of the association tests, on the construction of Chi-square test statistics. The relative values and the statistically significant associations resulting from crossing categories of variables were evaluated, with reference to a degree of error

of less than 5% or statistical significance ($P < 0.05$) and associated test Cramer's V, varying between 0 and 1, which allows a reading of the intensity of association between variables. While there is no standardization in the reading of the values of Cramer's V test, we considered noteworthy associations over 0.300 (Pestana and Gageiro 1998).

In order to test relationships between proposed risk factors and dog infection, categories of variables were cross tabulated, namely the number of own dogs and the practice of feeding viscera to the dogs; the visualization of cysts and offal disposal; practices of deworming dogs and home slaughtering; contact of dogs with other animals, deworming practices and positive coprology; and practices of deworming dogs/home slaughtering and interest in receiving information.

Results

Questionnaires

Three hundred sheep and goat farms were visited with the purpose of administering questionnaires to farmers and 279 questionnaires were completed. The questionnaires were collected from 41 of the 51 civil parishes of the county. Most of the farmers (55.9%, $n = 156$) had an age that ranged between 50 and 70 years old. Seventy-four (26.5%) farmers aged between 30 and 50, 46 (16.5%) farmers were more than 70-year old and only 1.1% ($n = 3$) were less than 30-year old. Farmers own a mean of 10–11 sheep (range: 0–200), 3–4 goats (range: 0–150), 0–1 cows (range: 0–60), 0–1 pigs (range: 0–100) and 2–3 dogs (range: 0–50). Two hundred and thirty-six (84.6%) farmers had at least one dog. The distribution of the animals from the respondents through the county is presented in Figure 2.

With respect to the risk practices of the farmers (Table 1), 69.2% of the farmers admitted to do *home slaughtering*, but only 3.1% claimed to have seen *cysts* in viscera. The majority *bury* the viscera, however, a remarkable number *feed viscera to their dogs*, and 11.1% of these farmers feed them *raw*. Farmers also *buy viscera from the butcher* (24.6%) to feed their dogs.

There is a noteworthy statistical association ($P < 0.001$; Cramer's $V = 0.396$) between the number of dogs owned and feeding them viscera raw or cooked: 85.4% of the farmers that feed cooked viscera own 3 or less dogs, and 50.0% of the farmers that feed raw viscera own 3 or more

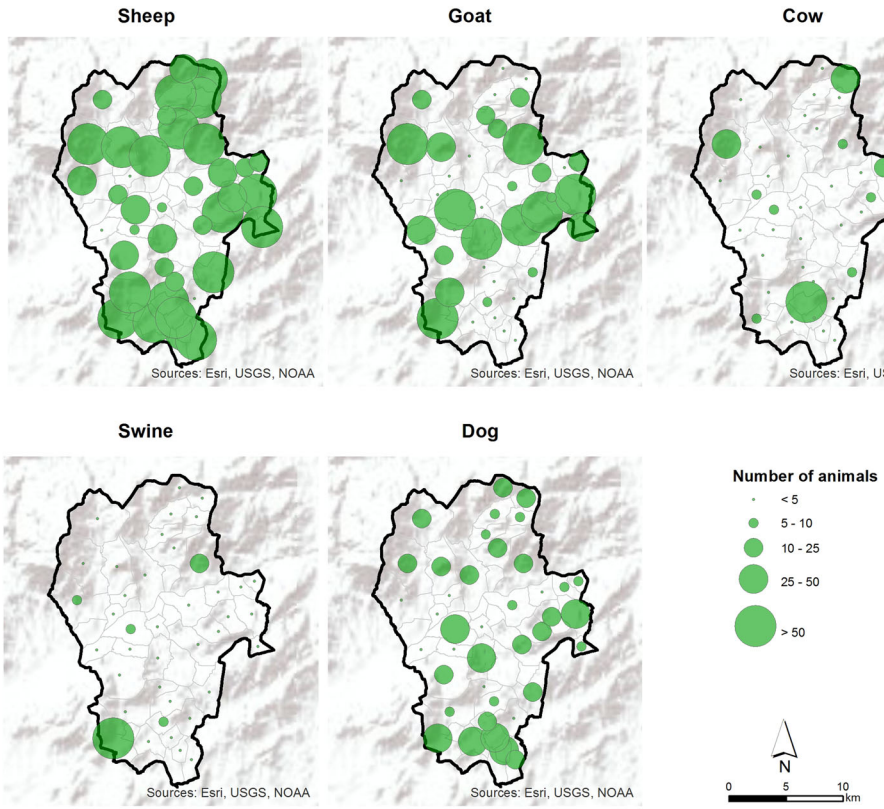

Figure 2. Distribution and number of the different animal species through the county of Ponte de Lima.

Table 1. Risk Practices of the Farmers.

	%/*n* of respondents
Home slaughtering (n = 279)	
Yes	69.2 (n = 193)
No	30.8 (n = 86)
Visualization of hydatid cysts at home slaughtering (n = 193)	
Yes	3.1 (n = 6)
No	96.9 (n = 187)
Offal disposal (n = 193)	
Eaten by farmers themselves	8.8 (n = 17)
Fed to dogs	28.0 (n = 54)
Buried	49.7 (n = 96)
Disposed of in the trash bin	7.8 (n = 15)
Others	5.7 (n = 11)
Feeding offal to dogs (n = 54)	
Raw	11.1 (n = 6)
Cooked	88.9 (n = 48)

Table 2. Dog-Keeping Practices of the Farmers.

	%/*n* of respondents
Deworming dogs (n = 236)	
Yes	54.2 (n = 128)
No	45.8 (n = 108)
Anthelmintic used (n = 128)	
Do not know	64.1 (n = 82)
Tablet	19.5 (n = 25)
Injectable	5.5 (n = 7)
Paste	2.3 (n = 3)
Ivomec®	7.0 (n = 9)
Strongid®	0.78 (n = 1)
Drontal®	0.78 (n = 1)
Frequency of the treatment (n = 128)	
Once a year	67.2 (n = 86)
More than once a year	32.8 (n = 42)
Contact of dogs with other animals (n = 236)	
Yes	54.7 (n = 129)
No	45.3 (n = 107)

dogs. Regarding the dog-keeping practices (Table 2), 54.2% of the farmers reported to *deworm the dogs*. Nevertheless, in relation to the *frequency of the deworming*, the majority of farmers answered that they did it *once a year*. In relation to the product used to deworm dogs, 64.1% of the farmers *do not know* what was used. Most of these dogs (54.7%) had *contact with other dogs or livestock*. There was a noteworthy statistical association ($P < 0.001$; Cramer's $V = 0.651$) between *contact with other dogs or livestock* and deworming; 54.7% (58/106) of the dogs that had not been dewormed had contact with other animals. Sixty percent (60.4%) of farmers who admitted not deworming also admitted to practicing home slaughtering ($P = 0.039$; Cramer's $V = 0.153$).

Finally, in relation to the degree of knowledge of the farmers (Table 3), 96.8% of them *have never heard* of the disease. The few farmers who claimed to know the disease were asked whether, according to them, the disease *can be transmitted to human beings*, and only 55.6% of these farmers *answered positively*. Two hundred and ten (75.3%) farmers demonstrated an *interest in receiving information* about hydatidosis. These respondents would like to receive this information mainly from a *veterinarian* and via *flyers*. Of the 69 farmers who declared no interest in receiving information, 71.0% practice home slaughtering and 54.7% do not deworm their dogs. Farmers who were from 30- to 50-year old and less than 30-year old were, respectively, the most and the least interested in receiving information.

Prevalence of Parasites Found in Shepherd Dogs' Faecal Samples

A single faecal specimen was collected from each of 88 farms. Parasitic forms were found in 54 of the samples (61.4%), representing seven different intestinal species. *Trichuris* spp. was the most prevalent (36.4%, 32/88), followed by Ancylostomatidae (29.6%, 26/88), *Toxocara* spp. (15.9%, 14/88), *Dipylidium caninum,* Taeniidae and *Moniezia benedeni/Moniezia expansa* (2.3%, 2/88 each one). Taeniidae eggs were identified as *Taenia* spp. rather than *E. granulosus*. The distribution of the most prevalent parasitic forms found in dog samples throughout the county is presented in Figure 3.

The majority of dogs were infected with single infections (37.5%, 33/88), but 23.9% (21/88) had multiple infections (up to four different parasites). Parasitic forms were found in 63.3% of the dogs that had contact with other animals, and in 58.3% of those who had not ($P < 0.001$; Cramer's $V = 0.223$). A relation between the previously identified risk factors and the presence/absence of parasitic forms in faeces was evaluated (Table 4). The presence of parasitic forms in faeces was not associated with previously identified risk factors including home slaughtering practices, feeding dogs with offal disposal, dog contact with other animals and lack of knowledge about hydatidosis ($P > 0.5$). The only marginally supported risk

Table 3. Knowledge of Farmers About Hydatidosis.

	%/*n* of respondents
Have heard about the disease (n = 279)	
Yes	3.2 (n = 9)
No	96.8 (n = 270)
Knowledge of its zoonotic potential (n = 9)	
Yes	55.6 (n = 5)
No	44.4 (n = 4)
Knowledge of the transmission routes to humans (n = 5)	
Do not know	40.0 (n = 2)
Eating raw meat	20.0 (n = 1)
Contacting animals	20.0 (n = 1)
Stool in cultures	20.0 (n = 1)
Interest in receiving information (n = 279)	
Yes	75.3 (n = 210)
No	24.7 (n = 69)
Preferred way of receiving information (n = 210)	
Veterinarian	47.1 (n = 99)
Flyers	39.1 (n = 82)
Physician	12.4 (n = 26)
Training	1.4 (n = 3)

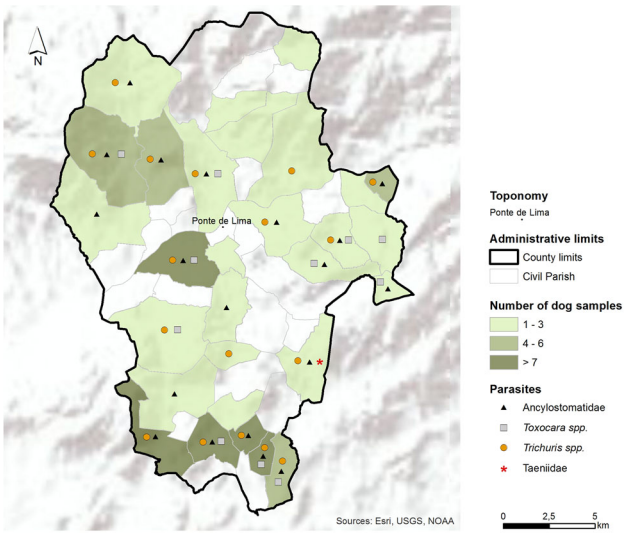

Figure 3. Distribution of the parasitic forms found in the 88 dog samples collected through the county of Ponte de Limaz.

factor for dog infection was for farms where dogs were not dewormed (χ^2 = 3.81, P = 0.15).

Discussion

Craig et al. (2007) demonstrated that agricultural workers, livestock ownership, living in a rural area with small private farms, and having contact with dogs are main risks factors for the occurrence of hydatidosis. The same authors have stated that the communities involved in sheep production have higher rates of infection, which justified the selection of these farmers in the present study. The risk factors previously cited were also identified in Portugal, considering data from 612 human cases between 1979 and 2003 (Morais 2007).

The most important aim of the present study was to identify sheep and goat farmers' awareness of hydatidosis. Crucially, this study revealed that only 0.7% (2 in 279) of the farmers are familiar with the disease and its transmission route. Public awareness of hydatidosis is low in Mediterranean countries (Seimenis 2003), and in this study we found that 96.8% of the farmers have never heard of the disease. This is an extremely high compared, for example, to findings in similar studies in Chile (55.0%) and Sardinia (15.0%) (Apt et al. 2000; Varcasia et al. 2011). In the present study, even farmers who reported knowing about the disease stated that it is not zoonotic and admitted to not deworming their dogs. This is of great concern, considering that previous research has demonstrated that the success of veterinary disease control measures largely depends on the knowledge of farmers (Munyeme et al. 2010). Health education in Ponte de Lima is therefore imperative, as advocated by several authors in relation to other geographical areas (Deplazes et al. 2011; McManus et al. 2003). Indeed, the absence of health education measures has been the reason why some hydatidosis control programmes have already failed in the past (Craig et al. 2007).

Being illiterate is also a risk factor (Seimenis 2003). Unfortunately, we have no data on the literacy of the respondents, but we can predict that the literacy is low, which is in part related to most of the farmers' age. In a recent publication of the Portuguese National Health Institute (Reis et al. 2014), from the 130 new cases of hydatidosis, 72% (94/130) occurred in adults older than 31-year old, and the adults with the highest number of infections were those older than 70-year old—most of the farmers who participated in the present study are between these ages. Similarly relevant, and maybe related to the degree of illiteracy of potential respondents, 11 farmers did not want to answer the questionnaire.

The traditional *home slaughtering practice* also constitutes a risk factor for hydatidosis. A study carried out in Sardinia concluded that home slaughtering took place in all farms (Varcasia et al. 2011). Similarly, in the present study, the majority of the farmers admitted to having done this

Table 4. Relation Between the Possible Risk Factors and the Coprology Results.

Risk factor (n)	Presence of parasitic forms in coprology (%)		Pearson's χ^2	P value
	Yes	No		
Home slaughtering practice (n = 53)	61.0	39.0	0.048	0.827
Feeding dogs with offal disposal (n = 59)	82.6	17.4	0.009	0.924
No deworming of dogs (n = 34)	67.6	32.4	3.810	0.149
Dogs having contact with other animals (n = 60)	63.3	36.7	1.112	0.574
Not knowing about hydatidosis (n = 83)	61.5	38.5	0.004	0.949

practice. This may be associated with the traditional collective slaughtering of animals, scheduled to coincide with religious or local festivities (Seimenis 2003). Culture and traditions are major factors that affect learning and understanding processes, including the perception of illness and health (Correa-Prisant 1999). As the nature and impact of these factors can differ from region to region, the importance of regional studies like the present one is noteworthy. Communication strategies about prevention measures should, therefore, be adequately tailored to each specific region and population (Hegglin et al. 2008).

Few farmers claimed to have seen cysts in viscera. Hydatid cysts starts as an oncosphere less than 30 μm in diameter (Bowman et al. 2004) and some cysts are not superficial but internal, thus difficult to identify. Consequently, it is understandable that few farmers have seen cysts in viscera. Meat inspection is the principal method applied in the control of *Taenia* spp. (Dorny et al. 2009), in general, and hydatidosis, in particular.

The transmission between intermediate and definitive hosts occurs through deliberate feeding of infected livestock to dogs, or through dogs scavenging carcasses of intermediate hosts (Jenkins et al. 2005). In the present study, the majority of the farmers that practice home slaughtering *bury* the viscera. Nonetheless, a remarkable number feed their dogs, which is consistent with the findings of Shaikenov et al. (2003). Some of these farmers feed raw viscera—including the owner of the largest number of dogs (n = 50) in this study—and dogs can be readily infected by this practice. Previous research has concluded that keeping a large number of dogs is a risk factor, and feeding them raw viscera increased four-fold the risk of hydatidosis (Campos-Bueno et al. 2000). Farmers from Ponte de Lima should be educated on appropriate viscera disposal. Burying viscera, if not done well, may allow carnivorous animals to eat viscera, which perpetuates the disease cycle. Viscera should, thus, be incinerated (Shaikenov et al. 2003).

Almost half of the farmers admitted to *not deworming* their dogs, which was marginally associated with odds of parasitism in the present survey of dogs. This is consistent with a study that has reported that more than half of dog owners in rural communities did not perceive diseases transmitted by dogs as a health problem (Ugbomoiko et al. 2008). Nevertheless, without information on dog zoonoses, owners are neither informed nor motivated to take the simple precautions necessary to protect themselves, their families and their animals (Pfukenyi et al. 2010). Given that *Taenia* species were found in the survey, it is reasonable to assume that *Echinococcus* might also be present, thus, continuous monitoring should be carried out. Faecal flotation is considered a very valuable method for the assessment of the majority of dog parasites, although it is less sensitive than others methods (Bowman et al. 2004). Faecal flotation monitoring may also increase awareness of other potential zoonotic parasites that may be present, as observed in this survey.

In Spain, short-term, periodic deworming of dogs has been one of the key points of control programs (Rojo-Vazquez et al. 2011). In contrast, in this study, the majority of the farmers admitted to deworming dogs only once a year. Annual or bi-annual treatments have no significant impact on preventing patent infection within a population (Sager et al. 2006). Praziquantel should be given every 6 weeks, but the majority of the farmers do not know what was used to deworm their dogs. From the remaining farmers who supposedly know what was used to deworm their dogs, most only referred to pharmaceutical forms and few mentioned commercial products. Control of hydatidosis is less effective without the support of the dog owners. After treatment, it is advisable to confine dogs for 48 h to

facilitate the collection and disposal of infected faeces (Taylor et al. 2007), however, as most of the dogs in the present study are free roaming, this recommendation is not followed.

More than half of shepherd dogs have contact with other animals. The presence of ruminant's tapeworm eggs in faecal dog samples suggests a high environmental contamination in these farms, and possible parasite cross contamination between animal species. *Echinococcus* eggs are immediately infective, so transmission to other animals through direct contact is a possibility (Jenkins et al. 2011). Moreover, dog faeces may contaminate human food and drinking water (Moro et al. 2008).

Two hundred and ten (75.3%) farmers demonstrated interest in receiving information about hydatidosis. Yet, it is disturbing that 69 (24.7%) of the farmers did not indicate any interest in receiving information. One may legitimately wonder why this is so. Of these 69 respondents, only one claimed to understand the disease. On the other hand, 88.9% of those who declared to know the disease were still interested in receiving information. The respondents would like to receive this information mainly from the veterinarian, which is consistent with the findings of other authors (Eckert et al. 2001). Nevertheless, for this to occur, veterinarians need to be aware of their function (Stull et al. 2007, 2013).

Previous studies clearly identified a lack of communication between patients and physicians regarding zoonotic risks associated with livestock production (Kersting et al. 2009), which may explain why, in this study, few farmers chose physicians for health education. Physicians believe that veterinarians should be involved in many aspects of zoonotic disease prevention, including patient education and providing information to patients and to physicians themselves (Grant and Olsen 1999). This is consistent with the conclusions reached by Kersting et al. (2009), whose survey demonstrated that over 50% of physicians were mostly uncomfortable with their knowledge of zoonoses. Indeed, consultation with a veterinarian may prove crucial when dealing with some human diseases, especially when similar signs are observed at a similar time in animals in close contact with the patient (Jackson and Villarroel 2012). Unfortunately, communication between physicians and veterinarians about zoonotic diseases is not frequent. Patients themselves do not appear to see veterinarians as a source of zoonotic disease information (Grant and Olsen 1999). Contrarily to these findings, farmers in Ponte de Lima do see veterinarians as a source of zoonotic disease information, suggesting that veterinarian practitioners are in close contact with the community in this region.

Apt et al. (2000) used a multidisciplinary approach to implement a health education plan, following the experience in countries that have been successful in controlling hydatidosis. Information campaigns should prioritize regions with high infection pressure and where levels of knowledge are poor, like the case in Ponte de Lima. Furthermore, information should target groups that are at higher risk. Decisions on control methodology need to take into account the social structure of the community. In the countryside, usually, all family members (including children) participate in the care of their animals and live very close to them (Seimenis 2003). Women should be targeted for health education, since they often make most nutritional and health-related decisions for the farmers and their families, particularly children. The information collected through farm visits, sample collection and analysis, and interviews in this survey should be used to develop culturally appropriate educational materials on zoonotic diseases. Indeed, the acceptance, compliance with and success of such materials could be greatly affected by the beliefs and customs of the target population (Correa-Prisant 1999). Mobilizing the local community resources and school-based health programmes are among the most cost-effective public health strategies (Bank 1993). The most powerful public health message in this context would be a combination of community-based animal health workers programmes, under the supervision of and report to veterinarians taking a farm health approach (Brook et al. 2010), with training provided by local residents in the administration of anthelmintic and showing macroscopic parasites to community members. The fact that only a few countries in the world have undertaken and successfully implemented control and/or elimination programmes reflects the complexity and diversity of factors contributing to the maintenance of this disease.

This study revealed a considerable degree of lack of knowledge of hydatidosis, in particular, and parasitic disease, more generally, in the region of Ponte de Lima. Although *E. granulosus* was not found, there is a high prevalence of potentially zoonotic parasites infecting dogs. Health education especially developed for farmers, women and children, and a closer collaboration between human and veterinary medicine is needed, in the light of a One Health approach. Prevention of zoonoses requires a global commitment; nevertheless, the main task still falls on local populations. Public awareness is thus a pressing need.

Acknowledgments

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